

SILO PROTECTION SYSTEMS

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SILO PROTECTION - The basic principle

What is it and why have it ?

Many industries such as food, pharmaceutical and quarry, handle and transport millions of tonnes of product every year. This product comes in many different shapes, sizes and densities, but a great deal is shipped in powder and particulate form. These products are shipped from site to site, mainly by road tanker, and are then discharged from the tanker to the site's silos by fluidising the powder and blowing it into the silo.

This pneumatic conveying operation uses air to carry the product into the silo and this air must then be vented via a suitable filter. Silo protection is necessary to prevent :

- 1) Over-pressurisation.** If the air is not vented then the silo can become pressurised and most silos are not tested as pressure vessels. Indeed, only a small increase (such as 1 psi) may be sufficient to either rupture the silo or blow the filter element off the silo roof.
- 2) Over-filling.** Another common problem is over-filling the silo when either the level probe has failed or it is the wrong unit for the application. Both of these conditions necessitate the need for a silo protection system.

Without protection what is likely to happen ?

The effect of over-pressurising a silo can be disastrous, resulting in damage to the silo and an unquantifiable risk to personnel and the public. Over-filling a silo, whilst less onerous, also presents a real risk to the local environment.

- 1. Damage to silo :** Resulting in loss of production and expensive repair or replacement of the silo or filters, as well as costly clean up operations.
- 2. Dangerous situation :** Operator safety is at risk from heavy filter units falling from great heights. This has serious health and safety implications.
- 3. Overspill of product :** Emissions to atmosphere could have a serious effect on the environment especially if the product is corrosive or hazardous and may result in large fines.

The risks associated with the above can be avoided if a basic Silo Safety System is in place but it is essential that the sensing elements of this system can be tested in-situ prior to each and every pressurised fill. All safety systems for pneumatically filled silos should have two sensing elements and a pressure relief valve.

- (1) PRESSURE SENSOR**
- (2) LEVEL SENSOR**
- (3) PRESSURE RELIEF VALVE**

These three elements together provide warnings of approaching danger and ultimately provide relief of dangerous pressure, if the sensors are ignored. Monitoring the level and pressure allow other control functions to be activated such as:

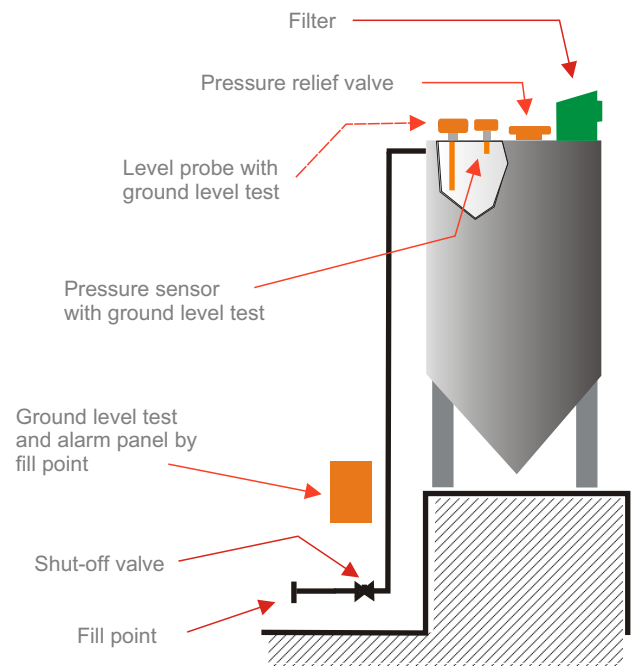
High level alarm

High pressure alarm

Tanker fill pipe shut-off

Activate filter alarms

Alarm on a PRV event pressure



AS WITH ALL SAFETY AND PROTECTION SYSTEMS MAINTENANCE AND REGULAR TESTING OF THE SYSTEM IS ESSENTIAL

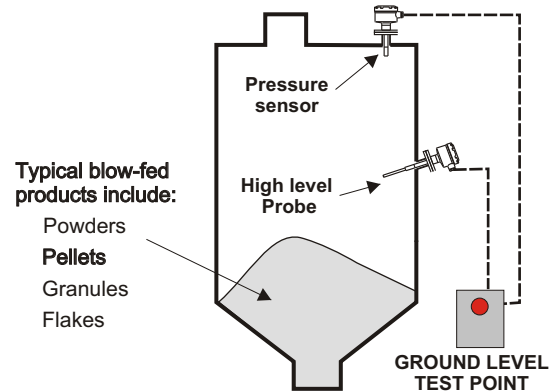
SILO PROTECTION - Primary Sensing Elements

PRESSURE AND LEVEL SENSORS MUST HAVE GROUND LEVEL TEST

These sensing devices are the heart of the silo protection system and the correct choice of sensor is essential. Equally important is the facility to be able to test these devices prior to every silo fill. This test is often referred to as 'Ground Level Test' or 'GLT' and is a standard feature of Hycontrol's level and pressure sensors. GLT enables the user to test that the critical sensing components of the system are working correctly before each delivery, without climbing onto the silo.

- REDUCES:** **Overspills**
 Filter and silo damage
 Product loss
- AVOIDS:** **Costly maintenance**
 Expensive clean-ups
 Dangerous situations
- PROVIDES:** **A safer working environment**

The ground level test facility is a feature of the Flex-500 pressure sensor and is included in all Hycontrol's range of capacitive, admittance and vibrating probe level switches when they are specified for silo protection.



FLEX-500 Pressure Sensor

The sensor monitors the pressure in the silo and transmits it to the control panel where control actions and alarm signals can be initiated. Typically a pressure increase signal would be used to close the discharge valve in the fill pipe to stop the tanker over-pressurising the silo.

The FLEX-500 is an advance on other sensors currently in use. It is the only one that can carry out the following functions which are essential for a silo protection system:-

1. **Detect if the sensor is damaged or blocked**
2. **Self-clean the sensor before and after every delivery.**
3. **Test the sensor integrity and operation over its full working range.**

All of the above are carried out with the simple press of a button at ground level before a delivery takes place. This ensures that the primary element is working correctly and it is safe to unload the tanker.

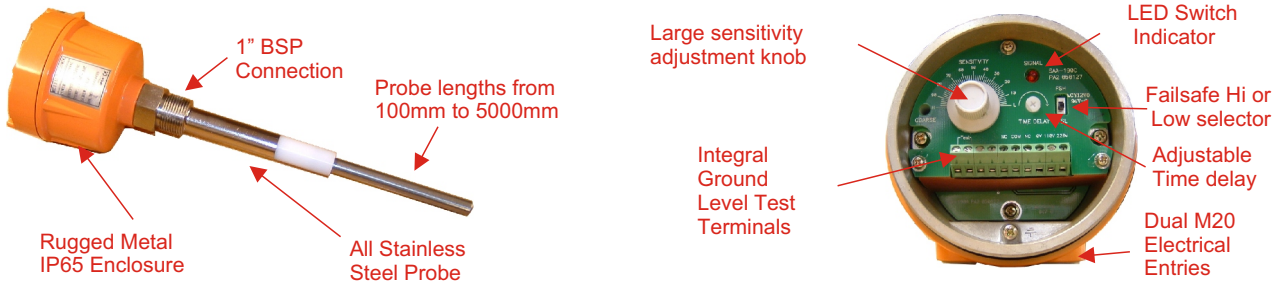
FLEX-500 Advantages

- Ground level test facility.
- Simple to install and commission.
- Wide range of pressure settings to suit majority of applications.
- 1" BSP process connection to enable simple retrofit.
- Corrosion resistant PVC nozzle.
- No moving parts or flexible rubber diaphragms on sensing element.
- High over-pressure rating for internal sensor.
- Reliable pressure monitoring of the silo.
- 2 wire loop powered connection to control panel.
- IP67 rugged GRP enclosure.
- M20 electrical entry with cable gland.
- Push-in connection for air supply.



High Level Sensor

This device will detect that the product in the silo has reached a predetermined level, normally within 10% of full, and activate an alarm. There are many technologies to do this and whilst Hycontrol has 6 different methods of determining a high level, the one most commonly used for many products in silos is capacitance. This has superseded the 'older' rotary paddle technology and has many advantages over it including no moving parts, ground level test and the ability to detect a wide range of materials with one standard sensor. Hycontrol has over 25 years of experience in level measurement and will recommend the product best suited for your application.



Pressure Relief Valve

The pressure relief valve is the silo's final form of defence against over pressure. This unit is normally fitted to the roof of the silo and prevents either an over pressure or negative pressure in the silo since both of these may cause severe damage.

This valve is available in a number of different materials and has a wide range of upstand adaptors to simplify retrofitting to existing silos. These units can be fitted with a range of proximity switches to test if the valve is functioning under a test condition. Stock pressure ratings vary from 100 to 900mm wg which covers virtually all silo applications. However, correct setting of the Flex-500 should always warn of an increase in the silo pressure before the relief valve is required to activate.

PLEASE NOTE

IT IS VERY IMPORTANT TO SPECIFY THE CORRECT VALVE FOR AN APPLICATION AND TO ENSURE IT IS LARGE ENOUGH TO SATISFY THE AIRFLOW EXHAUST REQUIREMENT. IF YOU ARE UNSURE THERE ARE GUIDANCE NOTES AVAILABLE SO PLEASE ASK



Control Panels



The control panel is designed to provide the control functions which complete the silo protection system. There are many different variations on the same theme and Hycontrol can offer a basic silo system right through to an out-of-hours delivery panel for multiple tank installations. The two standard panels offered are the basic low-cost version **HYCDPS500B** and an advanced **HYCDPS500A** which offers additional control functions and sensor input modules.

Control and display functions include:

- ◆ Silo control functions for filter units, shut off valves, alarms and sirens etc
- ◆ Recording number of events on incidents of over pressure or overflow.
- ◆ Authorised fill only via key switch.
- ◆ Filter cleaning option output
- ◆ Air supply monitoring alarm option
- ◆ Primary element testing (essential)



Associated Equipment

- ◆ Network enabling.
- ◆ Shut-off valves.
- ◆ Silo inlet locking devices.
- ◆ Airline and filter pressure switch.
- ◆ Continuous level measurement equipment.
- ◆ Alarm and display panels.
- ◆ Remote stock monitoring
- ◆ Installation and commissioning .